APPENDIX A: DESCRIPTION OF SIERRA NEVADA NETWORK PARKS

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I. DEVILS POSTPILE NATIONAL MONUMENT

PURPOSE AND SIGNIFICANCE

Devils Postpile National Monument was established to preserve “the natural formations known as the Devils Postpile and Rainbow Falls” for both scientific interest and for public inspiration and interpretation (NPS 1982). Devils Postpile is a dramatic mass of columnar-jointed basalt—the remnants of lava that flowed down the valley of the Middle Fork San Joaquin River less than 100,000 years ago. Approximately 20,000 years ago, a glacier overrode the fractured lava mass, exposing a wall of columns 18 meters high and resembling a giant pipe organ. Rainbow Falls, along the Middle Fork of the San Joaquin River, is a spectacular waterfall that drops 31 m (101 feet) over a volcanic cliff.

Yosemite National Park once administered the Devils Postpile area. In 1905, more than 1,295 square kilometers (500 square miles) were withdrawn from Yosemite National Park in the Minaret Range and the Devils Postpile area and returned to public domain. Only 324 hectares (800 acres) were returned to protected status as Devils Postpile National Monument in 1911 by Presidential Proclamation No. 1166 (under President William Howard Taft). Please see Appendix B for citation which contains additional details about this proclamation.

Devils Postpile National Monument is located high on the western slope of the Sierra Nevada in Madera County, California, near the headwaters of the Middle Fork of the San Joaquin River (Figure 1). Elevations within Devils Postpile range from 2,200 m to 2,500 m (7200-8200 feet). It is surrounded on all sides by the Inyo National Forest, and so comprises a small natural area within a much larger contiguous complex of federal public lands extending over a vast area of the eastern and western slopes of the Sierra Nevada range. Three-quarters of Devils Postpile is included within Ansel Adams Wilderness; this Wilderness extends into Inyo National Forest lands west of Devils Postpile. Ten kilometers (6 miles) to the east, and closely allied economically, is the resort town of Mammoth Lakes and the Mammoth Mountain ski complex.

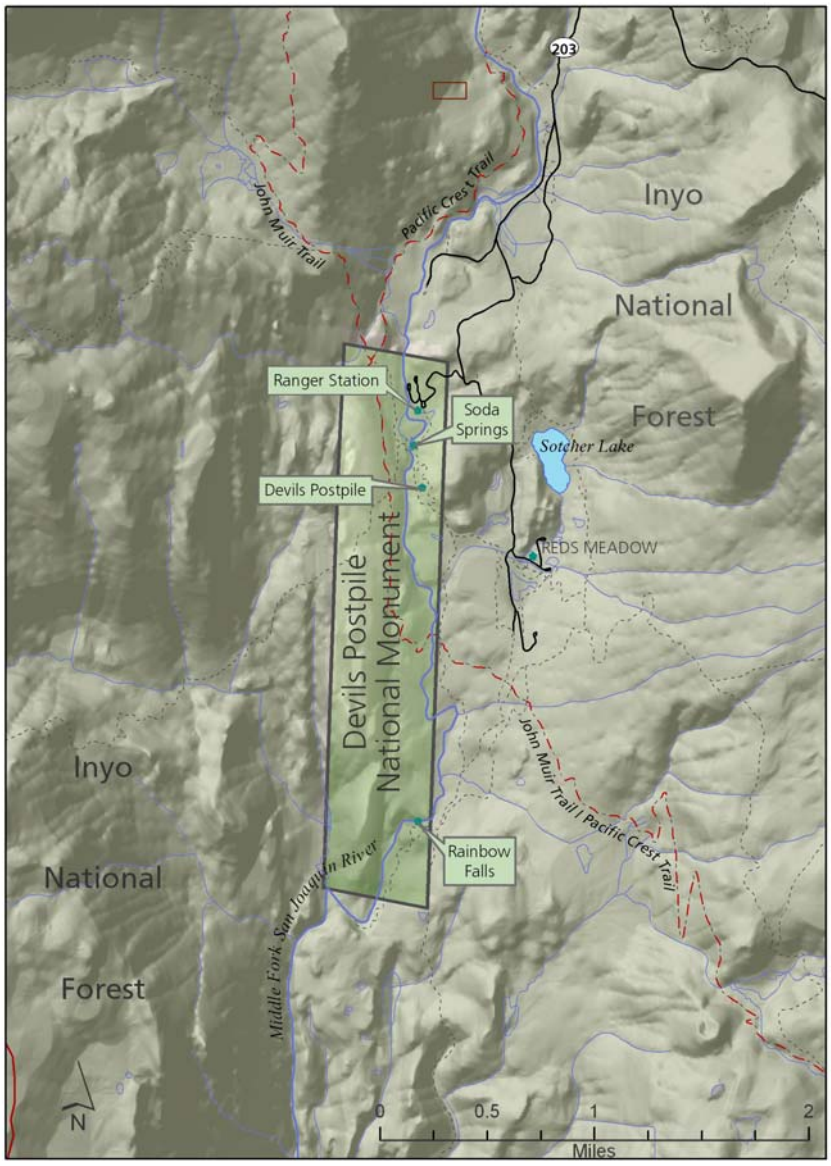

Figure 1. Devils Postpile National Monument and surrounding area.

DESCRIPTION OF RESOURCE VALUES

A country of wonderful contrasts.
Hot desertsbounded by snow-laden mountains, cinders and
ashes scattered on glacier-polished pavements,
frost and fire working together in the making of beauty.
–John Muir

As is evident from the basalt columns of Devils Postpile National Monument and glacial polish on the tops of the "postpile columns", the landscape of Devils Postpile National Monument was shaped by volcanism and ice. While glaciers are long gone from the Middle Fork of the San Joaquin drainage, volcanic influence is still strong within the Devils Postpile/Mammoth Lakes region. The region's soils have high concentrations of ash and tephra, and it is difficult to locate an area within the Devils Postpile not covered by pumice. The pumice indicates post-glacial volcanic activity in the Inyo/Mono Craters and Long Valley Caldera complex, and it plays an important role in the area's phytogeography and vegetation development.

On slopes underlain by basalt and andesite, where the water table is low and percolation is high, a sparse conifer forest typically exists. Here, pines and firs contribute little organic matter towards extensive soil formation. Instead, the soils remain barren with a paucity of litter and insufficient moisture to enhance soil formation. It is common, on steeper slopes, to see bare rock with few plants. What plants exist often creep downhill with the soil, further inhibiting soil development.

There continues to be volcanic activity in the Long Valley area, just west of Devils Postpile (Huber and Eckhardt 2002):

- Carbon dioxide gas has recently killed many trees at adjacent Mammoth Mountain
- Swarms of earthquakes occurred in the 1980s and 1990s, several of which dislodged postpile column pieces with Devils Postpile National Monument
- Numerous hotsprings are present in the region
- Pumice is young and widespread.

Further, future volcanic activity has the potential to dramatically change the landscape in and surrounding Devils Postpile National Monument. Based on the frequency of eruptions along the Mono-Inyo Crates volcanic chain in the past 5,000 years, the probability of an eruption occurring in any given year is somewhat less than one percent per year or roughly one chance in a few hundred in any given year. This is comparable to the annual chance of a magnitude 8 earthquake (like the Great 1906 San Francisco Earthquake) along the San Andreas Fault in coastal California or of an eruption from one of the

more active Cascade Range volcanoes in the Pacific Northwest, such as Mount Rainier in Washington or Mount Shasta in California.

Increased volcanic unrest (including earthquake swarms, ground deformation, and CO_2 gas emissions) in the Long Valley area since 1980 increases the chance of an eruption occurring in the near future, but scientists still lack adequate data to reliably calculate by how much. Volcanic unrest in some other large volcanic systems has persisted for decades or even centuries without leading to an eruption. But since volcanic unrest can escalate to an eruption quickly–in a few weeks, days, or less–USGS scientists continue to monitor the activity closely (http://lvo.wr.usgs.gov/hazards/index.html).

The Middle Fork of the San Joaquin River, which flows through Devils Postpile, is a Wild Trout River. Although the river was designated a 'Wild Trout River' due to its trout populations, highly valued by the recreational fishing community, none of the fish species are native to the river.

The river changes in character many times throughout its journey through Devils Postpile: from a series of broad low-gradient meanders, to scattered pools and fast-flowing rapids, cascades, and falls. South of Devils Postpile, the river continues on to race through a narrow granite gorge south of "Lost Camp" and towards Mammoth Pool (the first man-made obstruction on the San Joaquin River). Three small creeks enter the river within or near Devils Postpile National Monument: King Creek, Boundary Creek, and an unnamed creek from Red's Meadow (to the east).

Although the San Joaquin River drains the length of Devils Postpile into the San Joaquin Valley to the west, the Ritter Range west of Devils Postpile is higher in elevation. As a consequence, biological communities contained within have east-slope as well as west-slope affinities. The principal vegetation is montane forest, mostly dominated by red fir or lodgepole pine. Along the San Joaquin River, typical montane riparian vegetation dominates, represented by quaking aspen, black cottonwood, alder, and willows. A recent vascular plant inventory of Devils Postpile documented 360 taxa, a 113 percent increase from the 169 taxa documented previously (Arnett and Haultain 2004).

A number of meadows of various subtypes can be located within Devils Postpile. Dry meadows, where seeps or intermittent drainages occur, form shallow meadows occupied by sedges and grasses. In dry years these may not even "green up" after the snow melt. A few larger meadows occur in the southern monument region that are regularly wet and occupied by sedges, mannagrass, wildryes and other grasses. Some of these southern meadows are bordered with quaking aspen.

Soda Springs Meadow is the largest meadow within Devils Postpile. The large meadow is divided by the San Joaquin River and appears to be formed by

classic fluvial events. The soda spring for which this meadow is named is at the southern edge of the meadow. Totally submerged in the June snowmelt, the soda spring gradually becomes more accessible by July. Iron in the water oxidizes to reddish-brown and clearly marks the spring's location. The spring provides a continuous flow of carbonated water throughout the year.

A total of 143 vertebrates have been documented for Devils Postpile (Pierson and Rainey 2002, Gates and Heath 2003, Siegel and Wilkerson 2003, Werner 2004). The animals most frequently observed are birds, small diurnal mammals, and invertebrates. The most frequently seen birds include the Steller's jay, the western tanager, dark-eyed juncos, and hairy woodpeckers. Common mammals within Devils Postpile include the golden-mantled ground squirrel, the lodgepole chipmunk, chickaree, and Belding ground squirrels. Porcupines, coyotes, long-tailed weasels, martins, and marmots are occasionally sighted. Mule deer visit Soda Springs Meadow in the evening and early-morning hours. Black bears are frequently seen within Devils Postpile boundaries. During August of 2001, a survey of bats was conducted and ten species of bats were newly documented (Pierson and Rainey 2002), six of which are species of special concern.

Because of the cold climate, there are few known species of reptiles and amphibians within Devils Postpile. The Middle Fork of the San Joaquin has four nonnative species of trout, golden trout, rainbow trout, brown trout and brook trout. Many places throughout the Sierra Nevada, including Starkweather and Sotcher Lakes in the Reds Meadows area, are stocked with fish. Devils Postpile has not been stocked with fish since 1995.

The vegetation and wildlife in Devils Postpile are adapted to periodic fire, and evidence of past fires can be found in charcoal and fire scars left on some trees. Fire history and forest age structure studies are currently being conducted (Caprio, in progress). Fire history studies in similar forests in other areas of the Sierra Nevada have shown fires in lodgepole pine forests occurred an average of every 150 years and more frequently in lower elevation mixed conifer forests. The Rainbow Fire burned approximately two-thirds of Devils Postpile in 1992; the most severe burning occurred in the southeast portion. In some areas, tree mortality was high and seedlings have not re-established due to long distances to living trees. In other areas the fire crept along the forest floor, occasionally burning into trees – in these areas, re-establishment of seedlings has been more rapid.

Evidence of prehistoric human use of Devils Pospile has been documented, with several prehistoric sites identified based on the presence of tools, points, and chips. It is considered likely that this area was a locale for seasonal hunting and fishing camps used by Northern Paiute and/or Northfork Mono groups. However, the archeological sites are modest in size. Materials and analyses conducted thus far have not provided the basis for definitive conclusions about the people using the area and the nature of their use.

Historic uses of the area date from the 19th century. A toll road known as the French Trail, was developed in 1879-80 to connect the mining enterprises at Mammoth to the east with the Central Valley to the west. It passed through Reds Meadow, crossed the river and then continued up King Creek. Miners are also thought to have maintained camps in the area at this time and worked nearby mines. Some evidence also suggests late 19th century sheepherder camps within Devils Postpile. The remnants of "Postpile Joe's" trapper cabin dating from the early 20th century can still be seen.

An archeological survey within Devils Postpile was conducted in 1994, following the Rainbow fire. All existing structures, including the rustic ranger station, have been evaluated for historic significance, but were found not eligible for the National Register.

VISITOR USE

The primary period of public use for the area is in mid-June to the end of September, after the snow has melted and the road has become accessible to motor vehicles. Generally, the season extends from mid-June through October, but can vary depending on snowpack. Several hundred visitors also arrive in the winter by snowmobile and cross-country ski. This type of winter use is steadily growing.

Summer visitors arrive primarily by shuttle bus. Visit by private vehicle is not controlled in the spring or fall when the shuttle is not in operation. Visitor use has averaged 143,868 per year over the last three years. Daily visitor loads during the peak period average 2,000. The average length of stay for day users is estimated at four to five hours. Most campers stay an average of two and one half days.

Devils Postpile serves as a trailhead for backpackers using the Pacific Crest and John Muir Trails. These visitors leave their vehicles in the parking lot near the ranger station and spend an average of three days in the backcountry before returning to claim their vehicles. Horseback riders from the Reds Meadow Pack Station and long-distance hikers also pass through Devils Postpile on their way to the backcountry. Approximately 1500 horseback riders use Devils Postpile yearly, with about 1200 taking day trips to Rainbow Falls.

DEVELOPMENTS AND INFRASTRUCTURE

Access to Devils Postpile headquarters area is provided by a variable width paved road of approximately 0.34 miles. The narrower sections of the road can be problematic for larger vehicles, including the shuttle buses. The remainder of the park is accessible only by trails.

Unpaved parking accommodating approximately 60 cars is provided at the headquarters area for day visitors and long distance trail users. An additional unpaved parking lot on Forest Service land serves as a trailhead for day hikes to Rainbow Falls and also for long-distance trail users. Parking can be a significant problem, particularly when substantial numbers of backpacker vehicles are parked in the area and numerous private vehicles arrive after the shuttle operations have ended for the day. There are about five miles of unpaved trails in Devils Postpile, and two trail bridges across the Middle Fork San Joaquin River. One campground within Devils Postpile provides 21 sites for overnight visitors, and five additional campgrounds are on USFS land within several miles of its boundary.

A small ranger station of approximately 420 square feet provides multiple duty as a mini-visitor center, curatorial storage site, and park office. The building was originally located in Yosemite National Park and was moved to Devils Postpile in about 1946.

An administrative area is located near the ranger station, but out of the visitor circulation pattern. Five small, rustic wood-frame cabins provide housing for park employees. A small maintenance building provides some storage and workspace. A fire cache houses fire equipment.

II. SEQUOIA AND KINGS CANYON NATIONAL PARKS

PURPOSE AND SIGNIFICANCE OF THE PARKS

Sequoia and Kings Canyon National Parks protect a variety of landscapes, and biological and cultural resources, in the southern Sierra Nevada of California (Figure 2). Though juxtaposed, they are two separate national parks created by acts of Congress fifty years apart. Today, both parks are administered as a single unit.

Established September 25, 1890, Sequoia National Park is the second oldest national park in the United States. The campaign to create Sequoia–initiated and executed by San Joaquin Valley residents–focused on the scenic and inspirational values of the region's giant sequoia (California Big Tree *Sequoiadendron giganteum*) groves. The park's original boundaries were drawn to protect what local supporters believed were the largest and best of the unclaimed sequoia groves remaining in the world. One week later, under circumstances that have never been fully explained, Congress tripled the size of the new park, adding to it several sequoia groves already under the nominal control of logging enterprises. Eventually these groves were all preserved. Because the two acts of 1890 established boundaries along section lines, Sequoia National Park included not only giant sequoia forestlands but also considerable tracts comprising both the foothills and High Sierra. The October 1, 1890, act also created four-square-mile General Grant National Park to protect the General Grant Tree and immediately surrounding forest. Since 1890, Sequoia National Park has undergone two major enlargements, both of which added High Sierra lands to the park.

In 1926, Congress added what is known as the Great Western Divide, Kern headwaters, and Sierra Crest regions. This enlargement, which more than doubled the park's acreage, made it clear that Sequoia National Park would not only be a forest park, but also a superlative alpine park. Included within the enlargement areas was Mt. Whitney, the highest mountain in the contiguous United States. In 1978 Congress again enlarged Sequoia National Park, this time adding Mineral King area to park boundaries, previously a part of Sequoia National Forest. Alpine and subalpine in character, Mineral King basin had been proposed by the Forest Service for development as a major downhill ski resort. Congress added this basin to Sequoia National Park with specific instructions that it be preserved “undeveloped.” Please see Appendix B for additional details on legislation and special designations for Sequoia and Kings Canyon National Parks.

Today, the best known and most appreciated features of Sequoia National Park remain the sequoia groves and high country. In recent years, however, a new appreciation has developed which suggests that the park's "buffer lands" are far

more important than previously thought, and that the park's greatest value is in its wholeness. These themes are explored in more detail below.

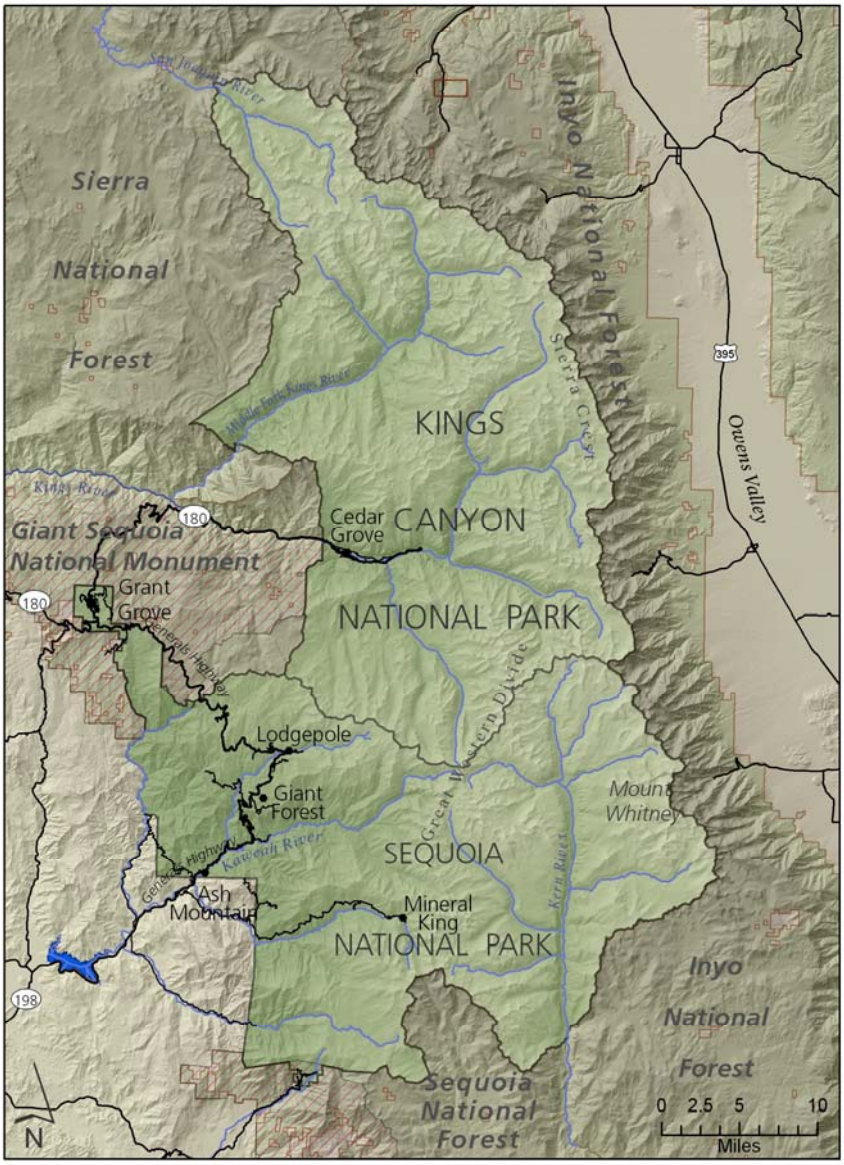

Figure 2. Sequoia and Kings Canyon National Parks.

The small General Grant National Park existed unchanged for fifty years. In 1940, however, responding to a two-decade-long political campaign, Congress created Kings Canyon National Park. In addition to incorporating the four square miles of General Grant National Park, and several other adjacent sequoia groves, Kings Canyon National Park featured great glacial canyons and scenic alpine headwaters of the South and Middle Forks of the Kings River. Because the new park contained two separate tracts, one featuring giant sequoia trees and the other canyons and alpine scenery, Kings Canyon's duality was readily apparent from the beginning. In 1940, as a political compromise, the “floors” of the parks two great glacial canyons–Kings Canyon and Tehipite Valley–were left outside its boundaries as possible reservoir sites—this situation was rectified in 1965 when Congress added them to the park.

DESCRIPTION OF RESOURCE VALUES
--Excerpted from NPS 1999, Resources Management Plan, Sequoia and Kings Canyon National Parks, p. 4

Sequoia and Kings Canyon National Parks contain resources of geological, biological, cultural, and sociological value. In addition to national park status, the two reservations have also been designated as a unit of the International Biosphere Preserve Program. In addition, 85% of land within the parks is designated wilderness.

The geological significance of the parks results primarily from the composition and structure of the Sierra Nevada, the highest mountain range in the 48 contiguous states. Geological resources include river-cut canyons more than a mile deep, extensive and spectacular examples of glacial erosion including hundreds of alpine lakes, and several superlative examples of glacially eroded canyons. The most famous of these–Kings Canyon–was once described by John Muir as a “rival of the Yosemite.” Within these canyons flows the largest remaining undammed rivers in the Sierra Nevada. Igneous rocks of Mesozoic origins underlie the majority of the two parks, but extensive bands of Paleozoic metamorphic beds also occur. Within the latter, beds of marble are common, as are caves.

The two parks contain over 200 known karst features. Several major cave systems have been located, including Lilburn Cave, which is the most extensive in California (over 17 miles of measured passages). The two parks contain some of the wildest and least-impacted caves in the United States.

Sequoia and Kings Canyon National Parks also contain biological resources of the great significance. Congress created Sequoia and General Grant National Parks in 1890 expressly to protect the giant sequoia. The General Sherman Tree, growing in Sequoia National Park's Giant Forest, is generally recognized as the largest sequoia and largest living tree on earth. Three other trees in the Giant

Forest, and General Grant Tree in Kings Canyon National Park, comprise the list of the world's five largest single organisms (excluding giant fungus, aspen clones, and barrier reefs).

Sequoia trees do not grow continuously through the mixed-conifer forest belt, but rather in geographically limited areas called groves. In the Sierra Nevada, the only present natural home of the sequoias, trees grow in 75 separate groves. While only thirty-seven of these groves are within the two parks, these groves contain more than 65% of all naturally occurring sequoias.

The biological resources of the two parks are not limited to giant sequoia. Extensive tracts of Sierran mixed-conifer forest surround sequoia groves. This forest belt, which generally clothes the mountains at altitudes between 5,000 and 9,000 feet (1,524 and 2,743 m), covers much of the southern Sierra. On surrounding lands, however, the great majority of this forest zone is being managed for multiple use. As a result, Sequoia and Kings Canyon National Parks now contain the largest remaining old growth forest in the southern Sierra. This forest is a very significant resource because its largely pristine nature gives it both a high recreational value and a critical scientific value. Below the conifer forest, in the western portions of the Sierra, are various plant communities and environments that together constitute the foothill region. Kings Canyon contains very little land within this natural zone; but, in Sequoia National Park, lower canyons of several forks of the Kaweah River include extensive foothill lands. This environment, typified by blue oak savanna, chaparral, and oak woodland, covers much of lowland Central California outside the parks. However, very little of this non-park land is receiving any protection. In the Southern Sierra Nevada, the foothill lands of Sequoia National Park are the only foothill tracts currently designated for long-term preservation.

The remainder of Sequoia and Kings Canyon National Parks, most of it above 9,000 feet (2,743 m) elevation, can be described as "high Sierra." This environment, which covers nearly as much acreage as the other environments combined, is a spectacular land of rugged, ice-sculptured alpine ridges and sparsely wooded lake-jeweled basins. As the heart of the largest wilderness area in California, these lands are of very high recreational and scientific significance.

Preservation of native wildlife within the two parks results naturally from habitat protection that the parks provide and adds yet another level of biological significance. While wildlife found within the parks does not differ significantly from that found naturally on surrounding lands, those lands are mostly undergoing profound change. As a result, the wildlife protection function of the parks is becoming increasingly important. Regional survival of a number of species may ultimately be largely dependent upon the protection the parks provide.

In addition to rich natural diversity, the parks preserve unique cultural and historical records. Eighteen sites or structures within the parks have been listed

on the National Register of Historic Places; another six are formally determined to be eligible. Known sites include 312 prehistoric and 110 historic. Site types include prehistoric villages, bedrock mortars and basins, rock art panels, campsites, hunting blinds, cattle and sheep camps, logging camps, sawmills, mines, dams, ranger stations, and CCC-era buildings and structures. The archeological evidence dates back at least five thousand years and indicates a wide-ranging presence throughout the Sierra Nevada of Native American peoples. Local logging, mining, and hydroelectric enterprises, closely related to the formation of the parks, illustrate a particular current of Western settlement and industry. Of the former, the Kaweah Colony, a Bay Area utopian collective which sought to log the sequoias, is unique in representing at once the confidence of industry and the idealism of the early labor movement. Finally, the historical primacy of Sequoia National Park and its unique course of development provide an invaluable and specifically shaded account of the emergence of the preservation ethic and evolution of the National Park Service.

At present, collections contain approximately 320,000 items. Of these, some 250,000 comprise the parks' archives: 46,000 items are included in the history collection, 12,000 in biology, and 11,000 in archeology. Smaller collections include geology (consisting of around 400 items), ethnology (some 100 items), and paleontology (consisting of 20 examples of fossilized sequoia wood).

The collection contains material from the disciplines of archeology, ethnology, and history and includes documentary material, photographs, fine art, and historic objects.

The sociological values and significance of Sequoia and Kings Canyon National Parks result directly from the quality of natural and cultural resources. The preeminent value of all the parks' resources is that they remain relatively unaffected by modern humans; or in the case of the parks' cultural resources, tell of the historical relationship between humanity and the natural environment. In all descriptions of the parks' resource values, the words "wild" and "natural" appear repeatedly. The value to humanity of the parks' many natural environments is greatly enhanced by their largely unimpaired nature. Both visitors and scientists come to the parks seeking a natural environment unaffected by modern humans. Recent legislation, including the 1978 Mineral King addition to Sequoia, the California Wilderness Act of 1984, the Chimney Rock Wilderness addition, and the addition of the Kings and Kern Rivers to the Federal Wild and Scenic River System, reinforces this theme. The ultimate value of the parks' archaeological resources derives from their ability to help modern humans understand early human's relationship to the natural world.

III. YOSEMITE NATIONAL PARK

PURPOSE AND SIGNIFICANCE OF THE PARK

In 1864, Yosemite Valley and the Mariposa Grove of Big Trees were granted by Act of the U.S. Congress to the State of California for "public use, resort and recreation," and to "be inalienable for all time." Thus, the significance of the area was recognized well before establishment of Yosemite National Park and nearly eight years before Yellowstone was set aside as the world's first national park. Landscape architect Frederick Law Olmsted, designer of New York City's Central Park, provided early direction in managing the Yosemite Grant and saw it as a museum of natural science and native species, and a field of study for art.

In 1906, Congress accepted transfer of the Grant back to the United States, adding it to Yosemite National Park, which had been established in 1890 "to preserve from injury all timber, mineral deposits, natural curiosities or wonders within the park area and to retain them in their natural condition." Several changes to the park boundary were made over the years. In 1984, Yosemite was designated a World Heritage Site.

Approximately 94% of Yosemite's acreage is designated Wilderness. Portions of the Tuolumne River (including the Dana and Lyell Forks), and the main stem and South Fork of the Merced River, are designated National Wild and Scenic Rivers. El Portal Administrative Site west of the park (approximately 566 hectares / 1,400 acres) was established by Act of Congress in 1958, for the purpose of relocating park facilities from within the core park boundary. U.S. Forest Service lands surround the park, and are divided into three national forests: Stanislaus, Toiyabe-Inyo, and Sierra.

The park's exceptional geological, biological, and scenic resources are contained within 308,075 hectares (761,266 acres / 1,189 square miles / 3,079 square km) of scenic wildland, parts of which were first set aside in 1864 (Figure 3). Yosemite preserves a portion of the western slope of the central Sierra Nevada. Please see Table B-1 for a summary of legislation and special designations for Yosemite National Park.

The region's beauty incited a profound human response that compelled John Muir and others to form the Sierra Club (one of the first private conservation organizations) and prepared the world for the idea of, and desire for, a "national park." This, in itself, is a profound legacy for the world.

> "Nowhere will you see the majestic operations of nature more clearly revealed beside the frailest, most gentle and peaceful things. Nearly all the park is a profound solitude. Yet it is full of charming company, full of God's thoughts, a place of peace and safety amid the most exalted grandeur and eager enthusiastic action, a new song, a place of beginnings abounding in first lessons on life, mountain-building, eternal, invincible,

> unbreakable order; with sermons in stones, storms, trees, flowers, and animals brimful of humanity." (Muir 1901).

Frederick Law Olmsted, considered to be America's premier landscape architect, aided this quest for a "public park" through his preliminary report on the Yosemite Valley and the Mariposa Big Tree Grove. This report encapsulated the character and value of the Yosemite region:

> "No photograph or series of photographs, no painting ever prepare a visitor so that he is not taken by surprise, for could the scenes be faithfully represented the visitor is affected not only by that upon which his eye is at any moment fixed, but by all that with which on every side is associated, and of which it is seen only as an inherent part."
>
> "[T]he union of deepest sublimity with the deepest beauty of nature, not in one feature or another, not in one part of scene or another, not in any landscape that can be framed by itself, but all around and wherever the visitor goes, constitutes the Yo Semite, the greatest glory of nature" (Olmstead 1865).

Figure 3. Yosemite National Park.

DESCRIPTION OF RESOURCE VALUES

Yosemite's landscape comprises a wide range of elevations, from its semi-arid foothills to its snowcapped crests—from 610 meters in El Portal, to 3,998 meters in height at Mount Lyell (range 2,000 to 13,123 feet). The park can be further divided into five major vegetative zones: chaparral/oak woodland, lower montane, upper montane, subalpine, and alpine. In addition to these impressive ecosystems, it includes three groves of Giant Sequoias and glacier-carved Yosemite Valley–with its abundance of waterfalls, cliffs, and extraordinary rock formations.

The climate of Yosemite, like the entire central Sierra Nevada, is Mediterranean—hot, dry summers and cool, moist winters. The foothills and lower slopes are semiarid, and the higher peaks and crests are also relatively dry; the majority of rain and snow falls at the middle elevations between approximately 1,220 and 2,743 meters (4,000 to 9,000 feet).

Dotted in among the forests, meadows, and broad expanses of rock are over 3,000 water bodies—each a reminder of the glaciers that gourged many basins in their slow, powerful journey. These sparkling jewels are located in the upper reaches of canyons and glacial amphitheatres around the peaks, primarily in the subalpine and alpine regions. Glacial meadows are spread over the filled-in basins of vanished lakes. In the Park's high country, the most extensive and well known meadows are the Tuolumne Meadows. Tuolumne Meadows is the largest subalpine meadow complex in the Sierra. In general, however, Yosemite is heavily forested. The size of individual trees and the diversity of species is due to climatic variation and topography that influence distribution of soils and moisture. The Park contains three giant Sequoia (*Sequoiadendron giganteum*) groves, though they do not compare to the number and grandeur of those found in Sequoia and Kings Canyon National Parks.

The geology of Yosemite is characterized by granitic rocks and remnants of older rock (Huber 1989), formed during three intrusions dating from 200 to 85 millions years ago.

In the early Tertiary period, 40 to 60 million years ago, the geologic environment of the Sierra Nevada region was lower in elevation, with a gently rolling upland surface. The Merced River flowed at a gentle gradient westward through a broad river valley.

About 10 million years ago, the Sierra Nevada was uplifted and then tilted to form its relatively gentle western slopes and the more dramatic, steep eastern slopes. The uplift increased the flow gradients, resulting in deep, narrow canyons.

Subsequent uplifting and erosion created the two major drainage basins: Merced and Tuolumne, both National Wild and Scenic Rivers. The Merced watershed begins in the Park's southern peaks, primarily in the Clark range. The South Fork of the Merced flows through the area of Wawona (a Miwok word which means "big tree", referring to the giant Sequoia), uniting with the main stem west of the Park boundary. The main stem of the Merced, growing from numerous tributaries, fills up lake basins such as Washburn Lake and Merced Lake before running through Yosemite Valley and the steep downstream Merced Canyon. The Park's largest river, the Tuolumne, drains the entire northern portion of the Park. Originating at Mount Lyell glacier (the second largest extant glacier in the Sierra Nevada), the Tuolumne flows through Lyell Canyon, Tuolumne Meadows, Glen Aulin, the Grand Canyon of the Tuolumne, and finally merges with the water

of the Hetch Hetchy reservoir on the Park's western boundary (an artificial lake impounded by a dam, part of San Francisco's water supply). Mount Lyell, the highest peak in Yosemite (3,998 meters /13,123 feet), occupies the apex of the range and drains into both Tuolumne and Merced watersheds.

About 1 million years ago, snow and ice accumulated, forming glaciers at the higher alpine elevations that began to move westward down the river valleys. The whole Sierra Nevada range was, at one time, covered with glaciers that furrowed canyons 610 to 1,829 meters (2,000 to 6,000 feet) deep. Ice thickness within Yosemite Valley may have reached 4,000 feet (1,219 meters) during the early glacial episode. Downslope movement of the ice masses cut and sculpted the U-shaped valley evident today. After the last glacier receded from the valley about 15,000 years ago, a lake referred to as Lake Yosemite was formed behind a "dam" of depositional materials left behind. More than 1,000 feet (914 meters) of glacial and stream sediments now comprise the floor of Yosemite Valley, covering glacially disturbed granitic rock (Huber 1989).

Such glacial action resulted in the final stripping of the metamorphic overlayer, leaving behind textbook-perfect glacial features for which Yosemite is known: domes, moraines, sheer rock walls, and hanging valleys. An equally rare and striking glacial phenomenon is "glacial polish" or "pavement." The glacial pavements are so young that erosive weathering has barely marred their brilliant beauty.

> "… Every peak, ridge, dome, canyon, lake basin, garden, forest, and stream testifies to the existence and modes of action of … scenery-making ice" (Muir, undetermined).

Yosemite Valley is the "world's most renowned example of a [glacially carved] valley" (Hill 1975), itself a single feature of beauty and fame that dramatically displays the varied rock forms created by glaciers. In no other canyon or valley is "magnitude, beauty, and accessibility so ideally combined as in Yosemite" (California Geological Survey 1869). Eight different granitic rock types occur in Yosemite Valley alone.

However, Yosemite Valley is not the only valley of note within the Park. A dozen miles to the north is the Grand Canyon of the Tuolumne River—a prodigious gash which exceeds Yosemite Valley in length and depth—which opens into Hetch Hetchy Valley.

A feature not restricted to Yosemite Valley—although many of the largest ones occur there—are great granite domes. Domes are rare on this planet and "the Yosemite region contains a greater and more varied assemblage of [domes and related] distinctive forms than any other area of similar extent in the Sierra Nevada or, perhaps, on Earth" (Matthes 1950).

However impressive Yosemite's geologic features are, the Park's waterfalls are often the natural feature most remembered by those who visit. There are two types of falls in Yosemite – those that leap free pouring from the lips of hanging valleys, and those that cascade in stair-step fashion in a canyon. "No where in the world are there waterfalls of such variety within a single area as those that leap into Yosemite Valley in the spring and early summer" (Schaffer 1978). The "waterfalls of the Yosemite region are relatively slender, resembling shimmering veils of ribbons fluttering from the cliffs" (Matthes 1950). Among Yosemite's waterfalls are some of the tallest and most spectacular of the "free-leaping" type which is relatively rare in nature. Yosemite has two of the world's ten tallest-known waterfalls (Yosemite and Ribbon Falls). Angel Falls in Venezuela at 979 meters (3,212 feet) is the tallest in the world; Yosemite Falls, at 739 meters (2,425 feet), is the tallest in the park.

Overview of Biological Diversity, Ecological Integrity, and Resource Issues

Humans have lived and sustained themselves in the region for at least 9,000 years and are part of the Sierra Nevada ecosystem. Indigenous populations were widely distributed throughout the area at the time of Euro-American immigrations. Archeological evidence indicates that for more than 3,000 years American Indians practiced localized burning, harvesting, pruning, irrigation, and vegetation thinning. Immigration of Euro-American settlers in the mid-1800s began a period of increasingly intense resource use and settlement (SNEP 1996). As in Sequoia and Kings Canyon National Parks, Yosemite fire history studies document a decline in frequent, widespread fires by the mid 1800s (Swetnam 1993, Swetnam et al. 1998). This disruption of fire regime was concommitant to introduction of large numbers of sheep and other livestock into higher elevation forests of the Sierra Nevada during and following the drought of the early 1860s (Swetnam et al. 1998).

Still, Yosemite National Park remains one of the largest and least-fragmented habitat blocks in the Sierra Nevada, and supports a diverse and abundant assemblage of plants and wildlife. As stated above, "[f]ew areas in the United States have more variety of native flora and fauna than the Sierra slopes" (Shaffer 1978). Its importance in protecting the long-term survival of certain species and overall biodiversity of vegetation and wildlife in the Sierra Nevada was recognized in congressional reports prepared as part of the Sierra Nevada Ecosystem Project (SNEP 1996). Yosemite possesses five of the seven recognized life-zones that occur in the United States. "Few areas in the United States have more variety of native flora and fauna than the Sierra slopes" (Shaffer 1978).

Today, most plant communities in Yosemite and other national park units within the Sierra Nevada Network are fairly intact as compared to similar non-Wilderness areas outside park boundaries. Much of this "pristine" quality can be attributed to relatively low levels of historic and/or recent human-caused

alteration, and lack of disruption of natural processes. Notable exception to this is the displacement by introduced Eurasian species of the native herbaceous understory of the meadows of Yosemite Valley and foothill savannas and woodlands of Sequoia National Park. However, impacts to plant communities, species, and individuals can be found throughout all parks. Past logging and grazing continue to affect hydrology and soils, and thus vegetation, in many areas of the parks, including parts of both subalpine and alpine environments.

The park's ecosystems depend upon dynamic natural processes. There exist ever-changing environments resulting from the presence or absence of fire, alterations in watersheds, and variations in climate.

More recent manipulations of the environment have resulted in alterations in vegetation in many locales. These forcing agents include suppression of natural fire frequencies, local water diversions or water impoundments, and development of infrastructure throughout non-Wilderness portions of the parks. In addition, changes in these natural processes of fire and flooding have resulted in changes in effects of re-introduced fire or floods, including sometimes greater fire intensities and severities in all parks, and depth of flooding, scour, and depositional patterns in Yosemite. Finally, the level of recreational use today in the most popular areas of the parks, although quite localized, has led to trampling, loss of vegetative cover, and increased susceptibility to the introduction of non-native plant species. The latter are brought in on vehicles, in construction and maintenance materials, as well as on the feet and hooves of visitors and their animals. All of these factors have lead to identification of management issues requiring far better inventory and monitoring data than presently exist.

Riparian and wetland areas contain important plant and animal habitat, yet they receive levels of recreational use out of proportion to their occurrence. Trampling and stream-bank damage associated with this use introduce disturbance factors that favor exotic plant establishment in areas especially susceptible to non-native intruders, further degrading this critical ecotonal habitat between aquatic and upland terrain.

In some park habitats—particularly chaparral, hardwood forest and woodland, and mixed-conifer—a long history of fire suppression has affected the natural structure and succession of plant communities, which has in turn affected habitat quality for both plants and wildlife. In some cases, this has also led to fires of unnaturally high intensity, which have drastically altered habitats for many years to come. In others, gaps that would otherwise form in conifer forest from natural fires (and thereby provide habitat for "forage" species) have been greatly reduced. Decades of fire suppression disrupted competitive balance between non-native and native plant species, and jeopardized the viability of some fire-dependent species. Yosemite National Park has used prescribed fire since 1970 and monitored lightning-ignited fires since 1972 to reduce fuels and return fire to

the landscape (van Wagtendonk 1977). Fire is a profoundly important ecological process in these systems, but both prescribed and wildland fires can create conditions that promote exotic plant establishment. On the other hand, fire suppression activities contribute to introduction of exotic plant propagules while creating conditions for their establishment.

Air pollution, especially in the southern Sierra Nevada, has affected vitality of some plant species studied, and may be extensively altering competitive balance and overall productivity of some plant communities. Global climate change, if it takes place as predicted, is expected to lead to striking changes in distribution, persistence, and character of many plant communities throughout their range.

Vegetation

Major vegetation zones in Yosemite form readily apparent, large-scale, north-south elevational bands along the axis of the Sierra Nevada. Major east-west watersheds that dissect the park into steep canyons form a secondary pattern of vegetation. Yosemite National Park supports five major vegetation zones: chaparral/oak woodland, lower montane, upper montane, subalpine, and alpine. The park is rich in plant diversity. Of California's 7,000 plant species, about 50% occur in the Sierra Nevada—more than 20% within Yosemite alone.

To date, 1,560 plant taxa are thought to occur within park boundaries. Documented records of, or suitable habitat for, 164 special-status plant species exist in the park. As a group, Sierra Nevada plants are most at risk where habitat has been reduced or altered. In some areas, rare local geologic formations and associated unique soils have led to evolution of ensembles of plant species restricted to these uncommon habitats. This is true in the El Portal area, where a number of state-listed rare species are sustained in a unique contact zone of metamorphic and granitic rock.

Although moderately extensive plot networks in Kings Canyon, Sequoia, and Yosemite have provided good information on distribution and habitat affinities of common species of plants, little is known regarding distribution of rare and special-status plant species (beyond some opportunistic surveys conducted during the 1980s and some work currently being conducted). Information on current population trends is non-existent, making impossible any comparisons of such information to trends on adjacent lands with differing management strategies.

Little-to-nothing is known about the diversity, distribution, and abundance of non-vascular plants within the park.

Wildlife

Wildlife populations in Sierra Nevada Network parks, as a whole, are thought to be relatively intact compared to other areas of the Sierra Nevada where human activities such as hunting, logging, grazing, fire suppression, and extensive development have led to widespread degradation, particularly in lower elevations outside designated wilderness.

In the parks, however, some human activities and development have affected wildlife and habitats. The most notable example is the inundation of Hetch Hetchy Valley by construction of O'Shaughnessy Dam across the Tuolumne River in Yosemite, destroying riparian, oak woodland, and wetland habitats that comprised a substantial portion of all bottomland winter habitat in that park. Similar habitats survive in Yosemite Valley, but roads and dense development in the east end of the Valley have eliminated or fragmented them; high levels of human activity from millions of visitors result in disturbance to wildlife. In Kings Canyon, Sequoia, and Yosemite, local areas of montane to subalpine habitats have been developed in ways detrimental to some native animals, but these represent a relatively minor proportion of available habitat.

To date, faunal composition of Yosemite is as follows:

- 82 native mammals (seventeen of those are bats—nine of which are either federal "Species of Concern" or State "Species of Special Concern").
- 273 birds (1 is listed as federally threatened; 13 are either federal "Species of Concern" or State "Species of Special Concern")
- 24 reptiles (2 are both federal "Species of Concern" and State "Species of Special Concern")
- 14 amphibians (5 are both federal "Species of Concern" and State "Species of Special Concern")
- 15 fish species (five of which are non-native)

For some species we know the reason(s) for decline; for others, we do not. For example, Pacific fishers (*Martes pennanti pacifica*) are present in very low numbers in the park. Road-kills and low numbers of an important prey species (porcupine, *Erethizon dorsatum*) may be explanations, but not enough information exists to determine causative factors. Bighorn sheep (*Ovis canadensis sierrae*)(State-endangered; being considered for federal listing) formerly populated the Sierra crest, but have been reduced to several remnant populations—none of which regularly occur in Yosemite. Reasons for their initial decline are unknown, though today they are frequently depredated by mountain lions. Grizzly bears (*Ursus horribilis*) once occurred in the park, but were extirpated from the state by the early 20th century. Black bears (*Ursus americanus*) are abundant in the park and are often involved in conflicts with humans that result in property damage, injuries to humans, and the necessity of euthanizing black bears that present a clear threat.

Introduction of non-native species has affected some native wildlife species in the parks. Introduction of several species of salmon fish to high-elevation lakes and streams that were naturally fishless radically altered faunal communities of those waters and is suspected to be the primary cause of disappearance of mountain yellow-legged frogs (*Rana muscosa*) from wide areas of its former range throughout the Sierra Nevada. Population declines of Yosemite toads (*Bufo canorus*)—and complete disappearance of foothill yellow-legged frogs (*Rana boylei*)—may also be at least partially due to non-native species. Bullfrogs (*Rana catesbeiana*) are present in Yosemite Valley, several lakes in the north part of Yosemite, and some foothill portions of Sequoia where foothill yellow-legged frogs, or California red-legged frogs (*Rana aurora draytoni*), a federal Threatened species, once existed. Bullfrogs also prey on western pond turtles found in Sequoia. Brown-headed cowbirds (*Molothrus ater*), recent arrivals in the Sierra Nevada, flourish at stables, campgrounds, and residential areas of the parks, affecting native bird species through nest parasitism.

Other adverse effects on park wildlife originate outside park boundaries. For example, Willow Flycatchers (*Empidonax traillii*), a federal Threatened species, have become recently rare in the parks, although their favored habitat, meadows with willow thickets, is largely intact. Sierra-wide decimation of Willow Flycatchers, primarily from grazing and clearing of habitat—and perhaps cowbird parasitism—has affected numbers of this species in the parks as well by reducing regional population size to such a low number that it is difficult for park populations to be self-sustaining. Such regional effects on habitat likely affect a wide range of species in parks that are migratory or rely on immigration of individuals from adjacent areas.

One federal Endangered invertebrate is known to occur within the park (Valley elderberry longhorn beetle (*Desmocerus californicus*). Little-to-nothing is known about the diversity, distribution, and abundance of most other invertebrates within Yosemite.

DEVELOPMENT AND INFRASTRUCTURE

Yosemite National Park has major developed areas in Yosemite Valley, Wawona, and Tuoloumne Meadows. Smaller developed areas include Aspen Meadows, Crane Flat, Hodgdon Meadow, Foresta, White Wolf, Porcupine Flat, Tioga Pass, Hetch Hetchy, South Entrance, Arch Rock and Glacier Point. Development zones, managed to provide roads and facilities to serve visitors and the management of the park, comprise approximately 13,000 acres, or 1.7% of the park. El Portal and Yosemite West abut the park.

In Yosemite Valley are Yosemite Village, Yosemite Lodge/Camp 4, Ahwahnee, Curry Village, Housekeeping Camp, the Campground complex, and Happy Isles. North and Southside Drives run from the west end of the valley at Pohono, east and looping to connect all developed areas in the east end of the valley. Infrastructure follows similar paths, and in some instances contributes to such problems as the draining of meadows.

Wawona is located along the South Entrance Road. This community of approximately 300 homes and vacation homes is served by a network of roads that branch from the Chilnualna Falls Road, which parallels a reach of the South Fork of the Merced River. Wawona Hotel and Pioneer Village are the major visitor services.

Tuolumne Meadows includes Tuolumne Lodge, Tuolumne Meadows Campground, parking and logistical support facilities for various day and overnight visitor activities. The Tioga Road follows the edge of Tuolumne Meadows, a fragile subalpine meadow, and in some locations contributes to conifer invasion and other impacts.

There are four main park entrances, each serving a major road corridor: Tioga Pass, along the Tioga Road; Big Oak Flat, along the Big Oak Flat Road; Arch Rock, along the All-Weather Highway from El Portal; and the South Entrance, along the south entrance road (Mariposa Grove Road and the Glacier Point Road begin along this road).

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